



SEQUENCE LISTING

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HIGUCHI, KYOKO
SUZUKI, KAZUYA
NISHIZAWA, NAOKO
NAKANISHI, HIROMI

<120> NICOTIANAMINE SYNTHASE AND GENE ENCODING THE SAME

<130> 71526-55107

<140> 09/674,337
<141> 2001-07-26

<150> PCT/JP99/02305
<151> 1999-04-30

<150> JP 10-137685
<151> 1998-04-30

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<170> PatentIn Ver. 3.2

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Ser Pro Val Asp Val Thr Lys Leu Ser Pro Glu His Gln Arg Met Arg
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Glu Ala Leu Ile Arg Leu Cys Ser Ala Ala Glu Gly Lys Leu Glu Ala
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His Tyr Ala Asp Leu Leu Ala Thr Phe Asp Asn Pro Leu Asp His Leu
85 90 95
Gly Leu Phe Pro Tyr Tyr Ser Asn Tyr Val Asn Leu Ser Arg Leu Glu
100 105 110
Tyr Glu Leu Leu Ala Arg His Val Pro Gly Ile Ala Pro Ala Arg Val
115 120 125
Ala Phe Val Gly Ser Gly Pro Leu Pro Phe Ser Ser Leu Val Leu Ala
130 135 140

Ala His His Leu Pro Glu Thr Gln Phe Asp Asn Tyr Asp Leu Cys Gly
 145 150 155 160

Ala Ala Asn Glu Arg Ala Arg Lys Leu Phe Gly Ala Thr Ala Asp Gly
 165 170 175

Val Gly Ala Arg Met Ser Phe His Thr Ala Asp Val Ala Asp Leu Thr
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Gln Glu Leu Gly Ala Tyr Asp Val Val Phe Leu Ala Ala Leu Val Gly
 195 200 205

Met Ala Ala Glu Glu Lys Ala Lys Val Ile Ala His Leu Gly Ala His
 210 215 220

Met Val Glu Gly Ala Ser Leu Val Val Arg Ser Ala Arg Pro Arg Gly
 225 230 235 240

Phe Leu Tyr Pro Ile Val Asp Pro Glu Asp Ile Arg Arg Gly Gly Phe
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Glu Val Leu Ala Val His His Pro Glu Gly Glu Val Ile Asn Ser Val
 260 265 270

Ile Val Ala Arg Lys Ala Val Glu Ala Gln Leu Ser Gly Pro Gln Asn
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Gly Asp Ala His Ala Arg Gly Ala Val Pro Leu Val Ser Pro Pro Cys
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Asn Phe Ser Thr Lys Met Glu Ala Ser Ala Leu Glu Lys Ser Glu Glu
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atc cag gcc gcc atc gcc gag ctg ccg tcg ctg agc ccg tcc ccc gag 153
 Ile Gln Ala Ala Ile Ala Glu Leu Pro Ser Leu Ser Pro Ser Pro Glu
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Val Asp Arg Leu Phe Thr Asp Leu Val Thr Ala Cys Val Pro Pro Ser	
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Pro Val Asp Val Thr Lys Leu Ser Pro Glu His Gln Arg Met Arg Glu	
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Tyr Ala Asp Leu Leu Ala Thr Phe Asp Asn Pro Leu Asp His Leu Gly	
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Leu Phe Pro Tyr Tyr Ser Asn Tyr Val Asn Leu Ser Arg Leu Glu Tyr	
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Glu Leu Leu Ala Arg His Val Pro Gly Ile Ala Pro Ala Arg Val Ala	
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Phe Val Gly Ser Gly Pro Leu Pro Phe Ser Ser Leu Val Leu Ala Ala	
130 135 140 145	
cac cac ctg ccc gag acc cag ttc gac aac tac gac ctg tgc ggc gcg	537
His His Leu Pro Glu Thr Gln Phe Asp Asn Tyr Asp Leu Cys Gly Ala	
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Ala Asn Glu Arg Ala Arg Lys Leu Phe Gly Ala Thr Ala Asp Gly Val	
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Val Glu Gly Ala Ser Leu Val Val Arg Ser Ala Arg Pro Arg Gly Phe	
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Val Ala Arg Lys Ala Val Glu Ala Gln Leu Ser Gly Pro Gln Asn Gly
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Asp Ala His Ala Arg Gly Ala Val Pro Leu Val Ser Pro Pro Cys Asn
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Phe Ser Thr Lys Met Glu Ala Ser Ala Leu Glu Lys Ser Glu Glu Leu
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Thr Ala Lys Glu Leu Ala Phe
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<212> PRT
<213> Hordeum vulgare

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Arg Glu Gly Leu Ile Arg Leu Cys Ser Glu Ala Glu Gly Lys Leu Glu
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Ala His Tyr Ser Asp Met Leu Ala Ala Phe Asp Lys Pro Leu Asp His
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Leu Gly Met Phe Pro Tyr Tyr Asn Asn Tyr Ile Asn Leu Ser Lys Leu
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 Arg Val Ala Phe Ile Gly Ser Gly Pro Leu Pro Phe Ser Ser Phe Val
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 Cys Gly Ala Ala Asn Asp Arg Ala Ser Lys Leu Phe Arg Ala Asp Arg
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 Ala Gly Glu Leu Ala Lys Tyr Asp Val Val Phe Leu Ala Ala Leu Val
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 His Met Ala Asp Gly Ala Ala Leu Val Val Arg Ser Ala His Gly Ala
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 Arg Gly Phe Leu Tyr Pro Ile Val Asp Pro Gln Asp Ile Gly Arg Gly
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 Gly Phe Glu Val Leu Ala Val Cys His Pro Asp Asp Asp Val Val Asn
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 Ser Val Ile Ile Ala Gln Lys Ser Lys Asp Val His Ala Asp Gly Leu
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<212> DNA

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 35 40 45
 Pro Pro Ser Pro Val Asp Val Thr Lys Leu Gly Pro Glu Ala Gln Glu
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 Met Arg Glu Gly Leu Ile Arg Leu Cys Ser Glu Ala Glu Gly Lys Leu
 65 70 75 80
 Glu Ala His Tyr Ser Asp Met Leu Ala Ala Phe Asp Asn Pro Leu Asp
 85 90 95
 His Leu Gly Ile Phe Pro Tyr Tyr Ser Asn Tyr Ile Asn Leu Ser Lys
 100 105 110
 Leu Glu Tyr Glu Leu Leu Ala Arg Tyr Val Arg Arg His Arg Pro Ala
 115 120 125
 Arg Val Ala Phe Ile Gly Ser Gly Pro Leu Pro Phe Ser Ser Phe Val
 130 135 140
 Leu Ala Ala Arg His Leu Pro Asp Thr Met Phe Asp Asn Tyr Asp Leu
 145 150 155 160
 Cys Gly Ala Ala Asn Asp Arg Ala Ser Lys Leu Phe Arg Ala Asp Thr
 165 170 175
 Asp Val Gly Ala Arg Met Ser Phe His Thr Ala Asp Val Ala Asp Leu
 180 185 190

Ala Ser Glu Leu Ala Lys Tyr Asp Val Val Phe Leu Ala Ala Leu Val
 195 200 205

Gly Met Ala Ala Glu Asp Lys Ala Lys Val Ile Ala His Leu Gly Ala
 210 215 220

His Met Ala Asp Gly Ala Ala Leu Val Val Arg Ser Ala His Gly Ala
 225 230 235 240

Arg Gly Phe Leu Tyr Pro Ile Val Asp Pro Gln Asp Ile Gly Arg Gly
 245 250 255

Gly Phe Glu Val Leu Ala Val Cys His Pro Asp Asp Asp Val Val Asn
 260 265 270

Ser Val Ile Ile Ala Gln Lys Ser Lys Glu Val His Ala Asp Gly Leu
 275 280 285

Gly Ser Ala Arg Gly Ala Gly Arg Gln Tyr Ala Arg Gly Thr Val Pro
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<212> DNA

<213> Hordeum vulgare

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Gly	Val	Phe	Pro	Tyr	Tyr	Ser	Asn	Tyr	Ile	Asn	Leu	Ser	Lys	Leu	Glu
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Ile Ala Gln Lys Ser Asn Asp Val His Glu Tyr Gly Leu Gly Ser Gly
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Gln Val Asp Ala Leu Phe Thr Glu Leu Val Ala Ala Cys Val Pro Ser
 35 40 45

Ser Pro Val Asp Val Thr Lys Leu Gly Pro Glu Ala Gln Glu Met Arg
 50 55 60
 Gln Asp Leu Ile Arg Leu Cys Ser Ala Ala Glu Gly Leu Leu Glu Ala
 65 70 75 80
 His Tyr Ser Asp Met Leu Thr Ala Leu Asp Ser Pro Leu Asp His Leu
 85 90 95
 Gly Arg Phe Pro Tyr Phe Asp Asn Tyr Val Asn Leu Ser Lys Leu Glu
 100 105 110
 His Asp Leu Leu Ala Gly His Val Ala Ala Pro Ala Arg Val Ala Phe
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 Ile Gly Ser Gly Pro Leu Pro Phe Ser Ser Leu Phe Leu Ala Thr Tyr
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 His Leu Pro Asp Thr Arg Phe Asp Asn Tyr Asp Arg Cys Ser Val Ala
 145 150 155 160
 Asn Gly Arg Ala Met Lys Leu Val Gly Ala Ala Asp Glu Gly Val Arg
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 Ser Arg Met Ala Phe His Thr Ala Glu Val Thr Asp Leu Thr Ala Glu
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 Leu Gly Ala Tyr Asp Val Val Phe Leu Ala Ala Leu Val Gly Met Thr
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 Ser Lys Glu Lys Ala Asp Ala Ile Ala His Leu Gly Lys His Met Ala
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<400> 11

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Met Asp Ala Gln Asn Lys Glu Val Asp Ala Leu Val Gln Lys Ile Thr
  1                      5                      10                      15

Gly Leu His Ala Ala Ile Ala Lys Leu Pro Ser Leu Ser Pro Ser Pro
          20                      25                      30

Asp Val Asp Ala Leu Phe Thr Asp Leu Val Thr Ala Cys Val Pro Pro
          35                      40                      45

Ser Pro Val Asp Val Thr Lys Leu Gly Ser Glu Ala Gln Glu Met Arg
          50                      55                      60

Glu Gly Leu Ile Arg Leu Cys Ser Glu Ala Glu Gly Lys Leu Glu Ala
          65                      70                      75                      80

His Tyr Ser Asp Met Leu Ala Ala Phe Asp Asn Pro Leu Asp His Leu
          85                      90                      95

Gly Met Phe Pro Tyr Tyr Ser Asn Tyr Ile Asn Leu Ser Lys Leu Glu
          100                     105                     110

Tyr Glu Leu Leu Ala Arg Tyr Val Pro Gly Gly Ile Ala Arg Pro Ala
          115                     120                     125

Val Ala Phe Ile Gly Ser Gly Pro Leu Pro Phe Ser Ser Tyr Val Leu
          130                     135                     140

Ala Ala Arg His Leu Pro Asp Ala Met Phe Asp Asn Tyr Asp Leu Cys
          145                     150                     155                     160

Ser Ala Ala Asn Asp Arg Ala Ser Lys Leu Phe Arg Ala Asp Lys Asp
          165                     170                     175

Val Gly Ala Arg Met Ser Phe His Thr Ala Asp Val Ala Asp Leu Thr
          180                     185                     190

Arg Glu Leu Ala Ala Tyr Asp Val Val Phe Leu Ala Ala Leu Val Gly
          195                     200                     205

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Met Ala Ala Glu Asp Lys Ala Lys Val Ile Pro His Leu Gly Ala His
 210 215 220

Met Ala Asp Gly Ala Ala Leu Val Val Arg Ser Ala Gln Ala Arg Gly
 225 230 235 240

Phe Leu Tyr Pro Ile Val Asp Pro Gln Asp Ile Gly Arg Gly Gly Phe
 245 250 255

Glu Val Leu Ala Val Cys His Pro Asp Asp Asp Val Val Asn Ser Val
 260 265 270

Ile Ile Ala His Lys Ser Lys Asp Val His Ala Asn Glu Arg Pro Asn
 275 280 285

Gly Arg Gly Gly Gln Tyr Arg Gly Ala Val Pro Val Val Ser Pro Pro
 290 295 300

Cys Arg Phe Gly Glu Met Val Ala Asp Val Thr His Lys Arg Glu Glu
 305 310 315 320

Phe Thr Asn Ala Glu Val Ala Phe
 325

<210> 12

<211> 1352

<212> DNA

<213> Hordeum vulgare

<400> 12

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ctgccgtccc tcagcccatc acccgacgtc gacgcgtctt tcaccgacct ggtcaccgcg 180
tgcgtccccc cgagccccgt ggacgtgacc aagctcgggt cggaggcgca ggagatgcgg 240
gagggcctca tccgcctctg tcccgaggcc gaggggaagc tggaggcgca ctactccgac 300
atgctggccg ccttcgacaa cccgctcgac cacctcggca tgttccccta ctacagcaac 360
tacatcaacc tcagcaagct ggagtacgag ctccctggcg gctacgtgcc gggcggcata 420
gcccgggccc ctgtcgcggt catcggtccc ggcccgtgct cgttcagctc ctacgtcctc 480
gccgctcgcc acctgccccg cgccatgttc gacaactacg acctgtgtag cgcggccaac 540
gaccgtgcga gcaagctgtt ccgcgcggac aaggacgtgg gcgcccgcac gtctttccac 600
accgcccagc tagcggacct caccgcgcag ctccgcgcgt acgacgtcgt ctccctggcc 660
gcgctcgtgg gcatggctgc cgaggacaag gccaaaggta ttccgcacct cggcgcgcac 720
atggcggacg gggcgggccc cgtcgtgcgc agtgcgagg cacgtgggtt cctctacccg 780
atcgctcgatc ccaggacat cggtcgaggg gggtttgagg tgctggccgt gtgtcacccc 840
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gaacgtccca acgggcgtgg tggacagtac cggggcgcgg taccggtggg cagcccggcc 960
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cgagggtagt gtgccaagta acagtgtgtc attataggtg taagtgttga gaataagacc 1260
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aagttggttg ctaaaaaaaaa aaaaaaaaaa aa 1352

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<210> 13
 <211> 329
 <212> PRT
 <213> Hordeum vulgare

<400> 13

Met	Asp	Ala	Gln	Ser	Lys	Glu	Val	Asp	Ala	Leu	Val	Gln	Lys	Ile	Thr
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Gly	Leu	His	Ala	Ala	Ile	Ala	Lys	Leu	Pro	Ser	Leu	Ser	Pro	Ser	Pro
			20					25					30		
Asp	Val	Asp	Ala	Leu	Phe	Thr	Asp	Leu	Val	Thr	Ala	Cys	Val	Pro	Pro
		35					40					45			
Ser	Pro	Val	Asp	Val	Thr	Lys	Leu	Ala	Pro	Glu	Ala	Gln	Ala	Met	Arg
	50					55					60				
Glu	Gly	Leu	Ile	Arg	Leu	Cys	Ser	Glu	Ala	Glu	Gly	Lys	Leu	Glu	Ala
65				70						75					80
His	Tyr	Ser	Asp	Met	Leu	Ala	Ala	Phe	Asp	Asn	Pro	Leu	Asp	His	Leu
				85					90					95	
Gly	Val	Phe	Pro	Tyr	Tyr	Ser	Asn	Tyr	Ile	Asn	Leu	Ser	Lys	Leu	Glu
			100					105						110	
Tyr	Glu	Leu	Leu	Ala	Arg	Tyr	Val	Pro	Gly	Gly	Ile	Ala	Pro	Ala	Arg
		115					120					125			
Val	Ala	Phe	Ile	Gly	Ser	Gly	Pro	Leu	Pro	Phe	Ser	Ser	Tyr	Val	Leu
	130					135					140				
Ala	Ala	Arg	His	Leu	Pro	Asp	Thr	Val	Phe	Asp	Asn	Tyr	Val	Pro	Val
145					150					155					160
Arg	Ala	Ala	Asn	Asp	Arg	Ala	Thr	Arg	Leu	Phe	Arg	Ala	Asp	Lys	Asp
				165					170					175	
Val	Gly	Ala	Arg	Met	Ser	Phe	His	Thr	Ala	Asp	Val	Ala	Asp	Leu	Thr
			180					185					190		
Asp	Glu	Leu	Ala	Thr	Tyr	Asp	Val	Val	Phe	Leu	Ala	Ala	Leu	Val	Gly
	195						200					205			
Met	Ala	Ala	Glu	Asp	Lys	Gly	Gln	Gly	Asp	Pro	His	Leu	Gly	Ala	His
	210					215					220				
Met	Ala	Asp	Gly	Ala	Ala	Leu	Val	Arg	Ser	Ala	His	Gly	Ala	Arg	Gly
225					230					235					240
Phe	Leu	Tyr	Pro	Ile	Val	Asp	Pro	Gln	Asp	Ile	Gly	Arg	Gly	Gly	Phe
				245					250					255	
Glu	Val	Leu	Ala	Val	Cys	His	Pro	Asp	Asp	Asp	Val	Val	Asn	Ser	Val
			260					265					270		

Ile Ile Ala Gln Lys Ser Lys Asp Met Phe Ala Asn Gly Pro Arg Asn
 275 280 285

Gly Cys Gly Gly Arg Tyr Ala Arg Gly Thr Val Pro Val Val Ser Pro
 290 295 300

Pro Cys Arg Phe Gly Glu Met Val Ala Asp Val Thr Gln Lys Arg Glu
 305 310 315 320

Glu Phe Ala Lys Ala Glu Val Ala Phe
 325

<210> 14
 <211> 1371
 <212> DNA
 <213> Hordeum vulgare

<220>
 <221> modified_base
 <222> (8)
 <223> a, c, g, t, unknown or other

<400> 14
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 tggtcaggta ccaagaagac ataaaaatgg acgcccagag caaggaggtc gacgcccttg 120
 tccagaagat caccggcctc cacgccgcca tcgccaagct gccctcgctc agcccgtccc 180
 cggacgtcga cgcgctcttc accgacctgg tcaccgctg cgtgcccccg agccccgtgg 240
 acgtgaccaa gctcgccccg gaggcgccagg cgatgcggga gggcctcatc cgcctctgct 300
 ccgaggccga gggcaagctg gaggcgccact actccgacat gctcgccgcc ttcgacaacc 360
 cgctcgacca cctcggcgtc tccccctact acagcaacta catcaacctc agcaagctcg 420
 agtacgagct cctcgcgcg ctaagtcccc gcggcacatc cccggccccg gtcgccttca 480
 tcggctccgg cccgctcccg ttcagctcct acgtcctcgc cgcgcgccac ctgcccgaca 540
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 gcgcggacaa ggacgtcggc gcccgcattg cgttccacac cgccgacgtc gcggacctca 660
 ccgacgagct cgctacgtac gacgtcgtct tctggccgc gctcgtgggc atggccgccg 720
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 tcatcatcgc gcagaagtct aaggacatgt ttgccaatgg acctcgcaac ggggtgtggg 960
 gacggtacgc gcgaggcacg gtgcccgttg tcagcccgcc ctgcagggtt gccgagatgg 1020
 tggcagacgt gacccagaag agagaggagt ttgccaaggc ggaagtggcc ttctgattgc 1080
 tgcgaggtca ccatccgtat gccgctgcta cctttcaata tcttgcaatc gtagggtggc 1140
 attttcctac tcttggttacg acctttcaaa tcatatgttg tttgtacca ataagtgaag 1200
 tgtgttgctt acacgcgcgt gtcttgatca ctcggtctct agaaggcagg gcagatcaag 1260
 agactgtgca aaggaaaaga aatgtgtgtt gttgtagggt tatgagttgg gagtaagatg 1320
 attctagttc aaaaaaaaaa aaaaaaaaaa aaaaaaaaaa aaaaaaaaaa a 1371

<210> 15
 <211> 324
 <212> PRT
 <213> Oryza sativa

<400> 15
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Leu His Ala Ala Ser Lys Leu Pro Ser Leu Ser Pro Ser Ala Glu Val
 20 25 30
 Asp Ala Leu Phe Thr Asp Leu Val Thr Ala Cys Val Pro Ala Ser Pro
 35 40 45
 Val Asp Val Ala Lys Leu Gly Pro Glu Ala Gln Ala Met Arg Glu Glu
 50 55 60
 Leu Arg Leu Cys Ser Ala Ala Glu Gly His Leu Glu Ala His Tyr Ala
 65 70 75 80
 Asp Met Leu Ala Ala Phe Asp Asn Pro Leu Asp His Leu Ala Arg Phe
 85 90 95
 Pro Tyr Tyr Gly Asn Tyr Val Asn Leu Ser Lys Leu Glu Tyr Asp Leu
 100 105 110
 Leu Val Arg Tyr Val Pro Gly Ala Pro Thr Arg Val Ala Phe Val Gly
 115 120 125
 Ser Gly Pro Leu Pro Phe Ser Ser Leu Val Leu Ala Ala His His Leu
 130 135 140
 Pro Asp Ala Val Phe Asp Asn Tyr Asp Arg Cys Gly Ala Ala Asn Glu
 145 150 155 160
 Arg Ala Arg Arg Leu Phe Arg Gly Ala Asp Glu Gly Leu Gly Ala Arg
 165 170 175
 Met Ala Phe His Thr Ala Asp Val Ala Thr Leu Thr Gly Glu Leu Gly
 180 185 190
 Ala Tyr Asp Val Val Phe Leu Ala Ala Leu Val Gly Met Ala Ala Glu
 195 200 205
 Glu Lys Ala Gly Val Ala His Leu Gly Ala His Met Ala Asp Gly Ala
 210 215 220
 Ala Leu Val Val Arg Thr Ala His Gly Ala Arg Gly Phe Leu Tyr Pro
 225 230 235 240
 Val Asp Pro Glu Asp Val Arg Arg Gly Gly Phe Asp Val Leu Ala Val
 245 250 255
 Cys His Pro Glu Asp Glu Val Asn Ser Val Val Ala Arg Lys Val Gly
 260 265 270
 Ala Ala Ala Ala Ala Ala Ala Arg Arg Asp Glu Leu Ala Asp Ser
 275 280 285
 Arg Gly Val Val Leu Pro Val Val Gly Pro Pro Ser Thr Cys Cys Lys
 290 295 300
 Val Glu Ala Ser Ala Val Glu Lys Ala Glu Glu Phe Ala Ala Asn Lys
 305 310 315 320
 Glu Leu Ser Val

<210> 16
 <211> 1372
 <212> DNA
 <213> *Oryza sativa*

<400> 16
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 ctggtcgaga agatcgccgg cctccacgcc gccatctcca agctgccgtc gctgagccca 180
 tccgccgagg tggacgcgct cttcaccgac ctctgcacgg cgtgcgtccc ggcgagcccc 240
 gtcgacgtgg ccaagctcgg cccggaggcg caggcgatgc gggaggagct catccgcctc 300
 tgctccgccg ccgaggggcca cctcgaggcg cactacgccg acatgctcgc cgccttcgac 360
 aaccgcgtcg accacctcgc ccgcttcccg tactacggca actacgtcaa cctgagcaag 420
 ctggagtacg acctcctcgt ccgctacgtc cccggcattg ccccccacccg cgtcgccttc 480
 gtcgggtcgg gcccgcgtgcc gttcagctcc ctctgtctcg ctgcgacca cctgccggac 540
 gcggtgttcg acaactacga ccggtgcggc gcggccaacg agcgggagag gaggtgttc 600
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 ctgacggggg agctcggcgc gtacgacgtc gtgttcctgg cggcgctcgt gggcatggcg 720
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 ctctcgtcgtc ggacggcgca cggggcgcg c gggttcctgt acccgatcgt cgatcccag 840
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 aactccgtca tcgtcgccc caaggtcggg ccgcgcgcgc cgcgcgcgc ggcgcgcaga 960
 gacgagctcg cggactcgcg cggcggtggt ctgccggtgg tcgggcccgc gtccacgtgc 1020
 tgcaaggtgg aggcgagcgc ggttgagaag gcagaagagt ttgccgcaa caaggagctg 1080
 tccgtctaac agccggacga tcgaaaggcg cactatatta tggcaataaa tcatattgatt 1140
 atacttatgc tgcatttgcg aagctaaggt atactatgca agccatatgt ttgtgttcgt 1200
 acgtgttgtt tgggacgtac agttgtgttg ttgtacgtcg tgaagtactg aagtgttcac 1260
 agtagatcac aagttcacag caatcaatga ggaccctgta agccagtgt aacgaggaac 1320
 atgccatctg tgtatgacag tgagaaatta tataagaaaa acattttgtg ac 1372

<210> 17
 <211> 320
 <212> PRT
 <213> *Arabidopsis thaliana*

<400> 17
 Met Ala Cys Gln Asn Asn Leu Val Val Lys Gln Ile Ile Asp Leu Tyr
 1 5 10 15
 Asp Gln Ile Ser Lys Leu Lys Ser Leu Lys Pro Ser Lys Asn Val Asp
 20 25 30
 Thr Leu Phe Gly Gln Leu Val Ser Thr Cys Leu Pro Thr Asp Thr Asn
 35 40 45
 Ile Asp Val Thr Asn Met Cys Glu Glu Val Lys Asp Met Arg Ala Asn
 50 55 60
 Leu Ile Lys Leu Cys Gly Glu Ala Glu Gly Tyr Leu Glu Gln His Phe
 65 70 75 80
 Ser Thr Ile Leu Gly Ser Leu Gln Glu Asp Gln Asn Pro Leu Asp His
 85 90 95

Leu His Ile Phe Pro Tyr Tyr Ser Asn Tyr Leu Lys Leu Gly Lys Leu
 100 105 110
 Glu Phe Asp Leu Leu Ser Gln His Ser Ser His Val Pro Thr Lys Ile
 115 120 125
 Ala Phe Val Gly Ser Gly Pro Met Pro Leu Thr Ser Ile Val Leu Ala
 130 135 140
 Lys Phe His Leu Pro Asn Thr Thr Phe His Asn Phe Asp Ile Asp Ser
 145 150 155 160
 His Ala Asn Thr Leu Ala Ser Asn Leu Val Ser Arg Asp Pro Asp Leu
 165 170 175
 Ser Lys Arg Met Ile Phe His Thr Thr Asp Val Leu Asn Ala Thr Glu
 180 185 190
 Ala Leu Asp Gln Tyr Asp Val Val Phe Leu Ala Ala Leu Val Gly Met
 195 200 205
 Asp Lys Glu Ser Lys Val Lys Ala Ile Glu His Leu Glu Lys His Met
 210 215 220
 Ala Pro Gly Ala Val Leu Met Leu Arg Arg Ala His Ala Leu Arg Ala
 225 230 235 240
 Phe Leu Tyr Pro Ile Val Asp Ser Ser Asp Leu Lys Gly Phe Gln Leu
 245 250 255
 Leu Thr Ile Tyr His Pro Thr Asp Asp Val Val Asn Ser Val Val Ile
 260 265 270
 Ala Arg Lys Leu Gly Gly Pro Thr Thr Pro Gly Val Asn Gly Thr Arg
 275 280 285
 Gly Cys Met Phe Met Pro Cys Asn Cys Ser Lys Ile His Ala Ile Met
 290 295 300
 Asn Asn Arg Gly Lys Lys Asn Met Ile Glu Glu Phe Ser Thr Ile Glu
 305 310 315 320

<210> 18

<211> 963

<212> DNA

<213> Arabidopsis thaliana

<400> 18

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 acgtgcttac ccacggatac aaacatcgat gtcacaaata tgtgtgaaga agtcaaagac 180
 atgagagcta atctcatcaa gctttgtggt gaagccgaag gttatttgga gcaacacttc 240
 tccacaattt tgggatcttt acaagaagac caaaaccac ttgaccattt acacatcttt 300
 ccttactact ccaactacct caagctagga aagctcgagt tcgatctcct gagccaacac 360
 tcaagccatg tccccaccaa gattgccttc gtgggttcgg gtccgatgcc tctcacatcc 420
 atcgtattgg ccaagtttca cctccccaac acgacgttcc acaactttga catcgactca 480

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cacgcaaaca cactcgcttc aaacctcgtc tctcgcgacc cggacctctc aaaacgcatg 540
atcttccaca caacggacgt actaaacgca accgaagccc ttgaccaata tgacgtcgtt 600
ttcttagcgg cgcttgtagg gatggacaaa gagtcaaagg tcaaagccat cgagcacttg 660
gagaaacaca tggctcctgg agctgttctt atgctaagga gggctcatgc tctcagagct 720
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catccaaccg atgacgtggt taactcgggt gtgatcgcac gtaagctcgg tggtcggacc 840
acgccccggg ttaatggtac tcgtggatgc atgtttatgc cttgtaactg ctccaagatt 900
cacgcgatca tgaacaaccg tggtaagaag aatatgatcg aggagttag taccatcgag 960
taa

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<210> 19

<211> 320

<212> PRT

<213> *Arabidopsis thaliana*

<400> 19

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Met Ala Cys Gln Asn Asn Leu Val Val Lys Gln Ile Met Asp Leu Tyr
  1          5          10          15

Asn Gln Ile Ser Asn Leu Glu Ser Leu Lys Pro Ser Lys Asn Val Asp
          20          25          30

Thr Leu Phe Arg Gln Leu Val Ser Thr Cys Leu Pro Thr Asp Thr Asn
          35          40          45

Ile Asp Val Thr Glu Ile His Asp Glu Lys Val Lys Asp Met Arg Ser
          50          55          60

His Leu Ile Lys Leu Cys Gly Glu Ala Glu Gly Tyr Leu Glu Gln His
          65          70          75          80

Phe Ser Ala Ile Leu Gly Ser Phe Glu Asp Asn Pro Leu Asn His Leu
          85          90          95

His Ile Phe Pro Tyr Tyr Asn Asn Tyr Leu Lys Leu Gly Lys Leu Glu
          100          105          110

Phe Asp Leu Leu Ser Gln His Thr Thr His Val Pro Thr Lys Val Ala
          115          120          125

Phe Ile Gly Ser Gly Pro Met Pro Leu Thr Ser Ile Val Leu Ala Lys
          130          135          140

Phe His Leu Pro Asn Thr Thr Phe His Asn Phe Asp Ile Asp Ser His
          145          150          155          160

Ala Asn Thr Leu Ala Ser Asn Leu Val Ser Arg Asp Ser Asp Leu Ser
          165          170          175

Lys Arg Met Ile Phe His Thr Thr Asp Val Leu Asn Ala Lys Glu Gly
          180          185          190

Leu Asp Gln Tyr Asp Val Val Phe Leu Ala Ala Leu Val Gly Met Asp
          195          200          205

Lys Glu Ser Lys Val Lys Ala Ile Glu His Leu Glu Lys His Met Ala
          210          215          220

```

Pro Gly Ala Val Val Met Leu Arg Ser Ala His Gly Leu Arg Ala Phe
 225 230 235 240

Leu Tyr Pro Ile Val Asp Ser Cys Asp Leu Lys Gly Phe Glu Val Leu
 245 250 255

Thr Ile Tyr His Pro Ser Asp Asp Val Val Asn Ser Val Val Ile Ala
 260 265 270

Arg Lys Leu Gly Gly Ser Asn Gly Ala Arg Gly Ser Gln Ile Gly Arg
 275 280 285

Cys Val Val Met Pro Cys Asn Cys Ser Lys Val His Ala Ile Leu Asn
 290 295 300

Asn Arg Gly Met Glu Lys Asn Leu Ile Glu Glu Phe Ser Ala Ile Glu
 305 310 315 320

<210> 20
 <211> 963
 <212> DNA
 <213> Arabidopsis thaliana

<400> 20
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 aacctcgaga gcttaaaacc atccaagaat gtcgacactt tggtcagaca acttggtgtcc 120
 acgtgcttac caacggacac gaacatcgat gtcacagaga tacacgatga aaaagtcaaa 180
 gacatgagat ctcatctcat caagctttgt ggtgaagccg aagggtattt agagcaaacac 240
 ttttcagcaa tcttaggctc ttttgaagac aacctcttaa accatttaca catcttcccc 300
 tattacaaca actatctcaa actaggcaaa ctcgaaattcg atctcctttc tcagcacaca 360
 acccatgtcc cgaccaaagt cgcctttatt ggttcgggtc cgatgccact tacttccatc 420
 gtcttggcca agttccacct ccccaacaca acgttcacac acttcgacat cgactcacac 480
 gccaacacac tcgcttcaaa cctcgtttct cgtgattctg acctttccaa acgcatgatt 540
 ttccacacaa ctgatgtatt aaacgctaag gaggggttag accaatacga tgttggtttc 600
 ttggcagctc ttgttgggat ggataaagag tcaaaggcca aagctattga gcatttagag 660
 aagcatatgg cccctggagc tgtggtgatg ctaagaagtg ctcatggtct tagagctttc 720
 ttgtatccaa tcgttgactc ttgtgatctt aaagggtttg aggtgttaac catttatcat 780
 ccgtctgacg acgtgggttaa ttcggtgggtc atcgcacgta agcttggtgg ttcaaattga 840
 gctcgaggca gccagatcgg acggtgtgtg gttatgcctt gtaattgctc taagggtccac 900
 gcgatcttga acaatcgtgg tatggagaag aatttgatcg aggagtttag tgccatcgag 960
 taa 963

<210> 21
 <211> 320
 <212> PRT
 <213> Arabidopsis thaliana

<400> 21
 Met Gly Cys Gln Asp Glu Gln Leu Val Gln Thr Ile Cys Asp Leu Tyr
 1 5 10 15

Glu Lys Ile Ser Lys Leu Glu Ser Leu Lys Pro Ser Glu Asp Val Asn
 20 25 30

Ile	Leu	Phe	Lys	Gln	Leu	Val	Ser	Thr	Cys	Ile	Pro	Pro	Asn	Pro	Asn		
		35					40					45					
Ile	Asp	Val	Thr	Lys	Met	Cys	Asp	Arg	Val	Gln	Glu	Ile	Arg	Leu	Asn		
	50					55					60						
Leu	Ile	Lys	Ile	Cys	Gly	Leu	Ala	Glu	Gly	His	Leu	Glu	Asn	His	Phe		
65					70					75					80		
Ser	Ser	Ile	Leu	Thr	Ser	Tyr	Gln	Asp	Asn	Pro	Leu	His	His	Leu	Asn		
				85					90					95			
Ile	Phe	Pro	Tyr	Tyr	Asn	Asn	Tyr	Leu	Lys	Leu	Gly	Lys	Leu	Glu	Phe		
			100					105					110				
Asp	Leu	Leu	Glu	Gln	Asn	Leu	Asn	Gly	Phe	Val	Pro	Lys	Ser	Val	Ala		
		115					120					125					
Phe	Ile	Gly	Ser	Gly	Pro	Leu	Pro	Leu	Thr	Ser	Ile	Val	Leu	Ala	Ser		
	130					135					140						
Phe	His	Leu	Lys	Asp	Thr	Ile	Phe	His	Asn	Phe	Asp	Ile	Asp	Pro	Ser		
145					150					155					160		
Ala	Asn	Ser	Leu	Ala	Ser	Leu	Leu	Val	Ser	Ser	Asp	Pro	Asp	Ile	Ser		
				165					170					175			
Gln	Arg	Met	Phe	Phe	His	Thr	Val	Asp	Ile	Met	Asp	Val	Thr	Glu	Ser		
			180					185					190				
Leu	Lys	Ser	Phe	Asp	Val	Val	Phe	Leu	Ala	Ala	Leu	Val	Gly	Met	Asn		
		195					200					205					
Lys	Glu	Glu	Lys	Val	Lys	Val	Ile	Glu	His	Leu	Gln	Lys	His	Met	Ala		
	210					215					220						
Pro	Gly	Ala	Val	Leu	Met	Leu	Arg	Ser	Ala	His	Gly	Pro	Arg	Ala	Phe		
225					230					235					240		
Leu	Tyr	Pro	Ile	Val	Glu	Pro	Cys	Asp	Leu	Gln	Gly	Phe	Glu	Val	Leu		
				245					250					255			
Ser	Ile	Tyr	His	Pro	Thr	Asp	Asp	Val	Ile	Asn	Ser	Val	Val	Ile	Ser		
			260					265					270				
Lys	Lys	His	Pro	Val	Val	Ser	Ile	Gly	Asn	Val	Gly	Gly	Pro	Asn	Ser		
		275					280					285					
Cys	Leu	Leu	Lys	Pro	Cys	Asn	Cys	Ser	Lys	Thr	His	Ala	Lys	Met	Asn		
	290					295					300						
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 aaacacatgg ctcttggtgc tgtgtctcatg cttaggagtg ctcatgggtcc gagagcgttt 720
 ctttatccga tcgttgagcc gtgtgatctt caggggttcg aggttttgtc tatttatcac 780
 ccaacagatg atgttatcaa ctccgtggtg atctctaaaa agcatccagt tgtttcaatt 840
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Leu Val Xaa Ala Cys Val Pro Xaa Ser Pro Val Asp Val Thr Lys Leu
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			20					25					30		
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			35					40				45			
Xaa	Xaa	Xaa	Asp	Val	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Gln	Xaa	Met	Arg
			50				55					60			
Xaa	Xaa	Leu	Ile	Xaa	Xaa	Cys	Xaa	Xaa	Ala	Glu	Xaa	Xaa	Leu	Glu	Xaa
65						70				75					80
His	Xaa	Xaa	Xaa	Xaa	Leu	Xaa	Xaa	Xaa	Asp	Xaa	Pro	Leu	Xaa	His	Leu
					85				90					95	
Xaa	Xaa	Phe	Pro	Tyr	Xaa	Xaa	Asn	Tyr	Xaa	Xaa	Leu	Xaa	Xaa	Leu	Glu
			100					105						110	
Xaa	Xaa	Leu	Leu	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa
		115						120					125		
Ala	Phe	Xaa	Gly	Ser	Gly	Pro	Leu	Pro	Xaa	Xaa	Ser	Xaa	Xaa	Leu	Ala
			130				135					140			
Xaa	Xaa	His	Leu	Xaa	Xaa	Xaa	Xaa	Phe	Xaa	Asn	Xaa	Xaa	Xaa	Xaa	Xaa
145						150				155					160
Xaa	Ala	Asn	Xaa	Xaa	Ala	Xaa	Xaa	Leu	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa
					165				170					175	
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			180					185						190	

'30

Xaa Xaa Leu Xaa Xaa Xaa Asp Val Val Phe Leu Ala Ala Xaa Val Gly
195 200 205

Met Xaa Xaa Xaa Xaa Lys Xaa Xaa Xaa Xaa Xaa His Leu Xaa Xaa His
210 215 220

Met Xaa Xaa Gly Ala Xaa Leu Xaa Xaa Xaa Xaa Xaa Xaa Xaa Arg Xaa
225 230 235 240

Phe Leu Tyr Pro Xaa Val Xaa Xaa Xaa Xaa Xaa Xaa Xaa Gly Phe
245 250 255

Xaa Val Leu Xaa Val Xaa His Pro Xaa Xaa Xaa Val Xaa Asn Ser Xaa
260 265 270

Xaa Xaa Xaa Xaa Lys Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa
275 280 285

Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa
290 295 300

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305 310 315 320

Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa
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Ile Gln Ala

<210> 31
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<213> Hordeum vulgare

<400> 31
Arg Glu Ala Leu Ile Arg Leu
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<210> 32
<211> 71
<212> PRT
<213> Oryza sativa

<400> 32

Met Glu Ala Gln Asn Gln Glu Val Ala Ala Leu Val Glu Lys Ile Ala
 1 5 10 15
 Gly Leu His Ala Ala Ile Ser Lys Leu Pro Ser Leu Ser Pro Ser Ala
 20 25 30
 Glu Val Asp Ala Leu Phe Thr Asp Leu Val Thr Ala Cys Val Pro Ala
 35 40 45
 Ser Pro Val Asp Val Ala Lys Leu Gly Pro Glu Ala Gln Ala Met Arg
 50 55 60
 Glu Glu Leu Ile Arg Leu Cys
 65 70

<210> 33

<211> 111

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<213> *Oryza sativa*

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 Pro Gly Ile Ala Pro Thr Arg Val Ala Phe Val Gly Ser Gly Pro Leu
 20 25 30
 Pro Phe Ser Ser Leu Val Leu Ala Ala His His Leu Pro Asp Ala Val
 35 40 45
 Phe Asp Asn Tyr Asp Arg Cys Gly Ala Ala Asn Glu Arg Ala Arg Arg
 50 55 60
 Leu Phe Arg Gly Ala Asp Glu Gly Leu Gly Ala Arg Met Ala Phe His
 65 70 75 80
 Thr Gly Asp Val Ala Thr Leu Thr Gly Glu Leu Gly Ala Tyr Asp Val
 85 90 95
 Val Phe Leu Ala Thr Leu Val Gly Met Ala Ala Glu Glu Lys Pro
 100 105 110

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<211> 64

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<213> *Hordeum vulgare*

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 Tyr Asp Val Val Phe Leu Ala Ala Leu Val Asp Met Ala Ala Glu Glu
 20 25 30

Lys Ala Lys Val Ile Ala His Leu Gly Ala His Met Val Glu Gly Ala
 35 40 45

Ser Leu Val Val Tyr Ser Ala His Gly Ala Arg Gly Phe Leu Tyr Pro
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<210> 35

<211> 19

<212> PRT

<213> Hordeum vulgare

<400> 35

Ala Phe His Thr Ala Glu Val Thr Asp Leu Thr Ala Glu Leu Gly Ala
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Tyr Asp Val

<210> 36

<211> 29

<212> PRT

<213> Hordeum vulgare

<400> 36

Ala Asp Gly Ala Val Leu Val Ala Arg Ser Ala His Gly Ala Arg Ala
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Phe Leu Tyr Pro Val Val Glu Leu Asp Asp Val Gly Arg
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<210> 37

<211> 20

<212> PRT

<213> Hordeum vulgare

<400> 37

Pro Glu Asp Ile Arg Arg Gly Gly Phe Glu Val Leu Ala Val His His
 1 5 10 15

Pro Glu Gly Glu
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